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ABSTRACT

Since there are many criticisms of self-reported assessments of technology use, it is important to observe the actual extent to which technology is used in classrooms and to look specifically at the technology use of individual students, because it may differentiate the academic success or failure of these students. The present study conducted systematic observations in multi-ethnic middle school mathematics classrooms to examine whether or not there were gender, ethnic, or grade-level differences in 1,315 students' use of technology. The school district selected for the study is located in the vicinity of a major metropolitan city in the south central United States. The multivariate analysis of results revealed that there were only grade-level differences among students in their use of technology. Contains 27 references. (MKR)

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Investigating Middle School Students' Technology Use in Mathematics Through Systematic Classroom Observation

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Abstract

The present study conducted systematic classroom observations in middle school mathematics classrooms to examine whether or not there were gender, ethnic, or grade-level differences in students' use of technology. The multivariate of analysis results revealed that there were only grade-level differences among students on their use of technology.

Overview

In the last two decades there has been a great deal of research that has employed systematic classroom observation techniques to investigate effective teaching at the elementary, middle, and high school levels (Brophy & Good, 1986; Evertson & Green, 1986; Galton, 1988). Although there have been several criticisms and cautions related to the use of structured observation techniques (Evertson & Green, 1986; Galton, 1988), several researchers have demonstrated how the use of observational techniques can improve teachers' classroom instruction (Stallings & Freiberg, 1991; Stallings, Needels, & Stayrook , 1979). One important area, however, that has not been widely investigated within the study of classroom observation is that of examining how systematic observations can help us understand the academic problems of individual students or individual groups of students. Most classroom observation research has either focused on teacher behaviors or general classroom behavior, and very little research has been specifically targeted at the classroom behaviors of individual students. This has been especially true in the area of technology, where studies often use survey reports to assess technology use in schools (Cohen & Fliess, 1979; Pagni, 1991; Terranova, 1990). Since there are many criticisms of self-reported assessments of technology use, it is important to observe the actual extent to which technology is used in classrooms and specifically look at the technology use of individual students because it may differentiate the academic success or failure of these students.

There have been a few studies that have used classroom observation to investigate technology use in multiethnic settings (Copley & Williams, 1992; Williams, Copley, Huang, & Bright, 1993), but these studies have not specifically examined differences among individuals or groups of students on the amount of time they use technology in their classes. Furthermore, many of the studies observing technology use have been generic (i.e., generalizing across grade levels and content areas), rather than specifically focused on a given subject and/or grade level (Gage, 1985, Gage & Needels, 1989; Needels & Gage, 1991).

The objective of the present study is to systematically observe the technology used in mathematics by middle school students from different ethnic groups, genders, and grade levels. More specifically, this study examines whether there are significant differences between middle school boys and girls of various ethnic groups and grade levels on their technology use observed in the classroom.

Methods

Subjects

The subjects in the present study were 1,315 middle school students from a multiethnic school district located within the vicinity of a major metropolitan city in the South Central region of the United States. The school district was selected because it had recently been awarded a grant from the Department of Education involving the integration of calculators in mathematics instruction. A great majority of the students were from lower-middle to upper- middle class families. They represented a better than average national achievement level. The gender distribution among these students was nearly equal: 49.4% female and 50.6% male. About 32% of the students observed were white, 26% were black, 20% were Hispanic, and 23% were Asian. About 38% of the students were sixth graders, 32% were seventh graders, and 30% eighth graders.

Instrument

The instrument used in the present study was a modified version of the Classroom Observation Schedule (COS) (Waxman, Wang, Lindvall, & Anderson, 1983). The COS is a systematic observation schedule designed to document observed student behaviors in the context of ongoing classroom instructional-learning processes. Individual students are observed with reference to (a) their interactions with teachers and/or peers and the purpose of such interactions, (b) the settings in which observed behaviors occur, (c) the types of material with which they are working, and (d) the specific types of activities in which they engage. For the present study, the type of technology used was added to the observation schedule and was the only scale used. Four indicators were used to measure the percentage of time that any calculator or computer was used. The median interater reliability (Cohen's Kappa) of this scale was found to be .98.

Procedures

Prior to the observation, all mathematics teachers had 12 hours of training in calculator use, and each student was issued a hand-on calculator. The observations were conducted in mathematics classes in the spring semester by trained observers. Both teachers and students were not notified of the purpose of observation. Arrangements were made to observe regular classroom processes; classes devoted to special activities (e.g., standardized tests, quizzes, etc.) were avoided. Stratified sampling techniques (i.e., gender and ethnicity) were used so that approximately six students from each class were randomly chosen to be included in the sample. Each student was observed for ten intervals (each interval was 30 seconds) during the approximately 50 minute data-collection period. A three-way multivariate analysis of variance (MANOVA) was used to determine if there were any statistically significant differences among students of various grade levels, genders, and ethnic groups on the amount of time they used a specific type of technology.

Because of the large sample size and the great variance between observations, the probability level was set at .01.

Results

The descriptive results indicate that on average calculators were used in mathematics about 25% of the time. Both the overhead projector calculators and computers that were used were observed less than 0.1% of the time, and no technology was used about 75% of the time. Of the 1,315 students observed, about 54% never used calculators, 22% used calculators over half of the time, and 9% of them used calculators all the time.

The MANOVA results indicated an overall significant multivariate effect for grade level on students' use of technology in the middle school mathematics class ($F(8, 2576) = 3.63$, $p<.001$). Follow-up univariate analysis of variance (ANOVA) revealed that the differences were found in the categories of "calculators" and "no technology". Table 1 reports the descriptive and univariate ANOVA results of technology used by students of different grade levels, ethnic groups, and genders.

Table 1
Descriptive and Univariate ANOVA Result of Technology Used by Students of Different Grade Levels, Ethnic Groups, and Gender.

By Grade

Item	6th grade (n=495) M	SD	7th grade (n=422) M	SD	8th grade (n=398) M	SD	*F*
1. Calculator	22.99	32.54	29.71	37.51	20.86	32.41	8.16*
2. Overhead projector calculator	0	0	0.12	1.21	0	0	4.04
3. Computer	0.15	2.10	0	0	0	0	1.93
4. No technology	76.88	32.54	70.20	37.51	79.20	32.33	8.33*

* $p<.001$

By Ethnicity

Item	White (n=419) M	SD	Black (n=336) M	SD	Hispanic (n=255) M	SD	Asian (n=305) M	SD	*F*
1. Calculator	24.87	34.87	22.84	32.86	24.96	35.56	25.44	34.30	.41
2. Overhead projector calculator	0.06	0.86	0	0	0.05	0.78	0.04	0.72	.52
3. Computer	0.09	1.83	0	0	0	0	0.12	1.60	.63
4. No technology	75.01	34.88	77.16	32.86	74.99	35.55	74.51	34.20	.43

By Gender

Item	Male (n=666) M	SD	Female (n=649) M	SD	*F*
1. Calculator	24.07	33.95	24.93	34.77	.17
2. Overhead projector calculator	0.02	0.48	0.06	0.85	1.46
3. Computer	0.11	1.81	0	0	1.81
4. No technology	75.84	33.93	75.02	34.75	.17

Seventh grade students were observed using calculators significantly more frequently than sixth or eighth grades ($F= 8.16$, $p<.001$). Consequently, they were observed less frequently not using technology ($F= 8.33$, $p<.001$) than students from other grades.

Although the differences were small and not statistically significant, Asian students were observed more frequently using calculators and computers than students from other ethnic groups. Black students were observed using all categories of technology less frequently than other ethnic groups. Girls were observed using calculators slightly more than boys, but only boys were observed using computers.

Discussion

The results of this study found that the computer was seldom utilized in mathematics classrooms. The very low percentage of use suggests that integrating technology in middle school mathematics classrooms has fallen short in some areas. Previous studies on computer use often measured the effects of special interventions (Nicholson & Wahl, 1988; Reglin, 1988). The present study which observed regular classroom interactions may provide a much more realistic assessment of what actually occurs in multiethnic, metropolitan school districts. Traditionally computer and calculator uses were considered to be effective in the improvement of teaching and learning in mathematics and science (Bitter & Hatfield, 1992; Funk, 1987; Hembree & Dessart, 1986). The very low percentage of computer and other technology use raises some concern. Barriers to computer and other technology use such as the requirement of computer expertise, difficulties with whole-class demonstration format and so forth need to be identified and overcome (Russek & Weinberg, 1991). Similar to the calculator use, the availability of computers in each classroom and teacher in-service training of how to

implement computers in classroom instruction may be part of the solution to enhance computer utilization in education.

Students' use of calculators was boasted by the provision of a free calculator for each student and teacher in-service training. Students used calculators about one quarter of the time they were observed. Seventh grade students, however, were observed using calculator activities significantly more than students from other grades. Some of the possible explanations for the grade differences may include mathematics content, teacher and student attitudes, and other factors.

Several prior research studies have reported differences between secondary school boys' and girls' use of technology and the reasons for the differences (Anderson, 1983; Arenz & Lee, 1990; Culley, 1988; Funk, 1987; Miura, 1986; Nielsen & Roepstorff, 1985; Voogt, 1987). Contrary to these previous findings, the present study found no statistically significant differences by gender on students' use of technology.

Students' ethnic group has been found to be related to the variance of their mathematics achievement (ETS, 1988), but the present study found that there were no differences among ethnic groups on the amount of students' use of technology. Since the present classroom observation study focuses on the quantity of technology used by middle school students in mathematics classes, additional observational data examining how the specific technology is used by students as well as by teachers may provide an insight to the quality of technology use.

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